COLUMBIA UNIVERSITY LIBRARIES
Special Collections
Spec Ms Coll Tesla

Tesla, Nikola
Tesla's New System of Fluid Propulsion
n.p., n.d.
t.ms., 20 p.

21380E

TESLA'S NEW SYSTEM OF FLUID PROPULSION

In subduing the forces of Nature to his service man must invariably avail himself of some process in which a fluid acts as carrier of energy, this being an essential step in any industrial undertaking dependent on mechanical power. Evidently then, a discovery or radical departure in that domain must be of extreme importance and far-reaching influence on the existing conditions and phases of modern life.

Fluid propulsion is now effected by means of pistons, vanes or blades, which entail complexity of construction and impose many limi-

TESLA'S NEW SYSTEM OF FLUID PROPULSION

In subduing the forces of Nature to his service man must invariably avail himself of some process in which a fluid acts as carrier of energy, this being an essential step in any industrial undertaking dependent on mechanical power. Evidently then, a discovery or radical departure in that domain must be of extreme importance and far-reaching influence on the existing conditions and phases of modern life.

Fluid propulsion is now effected by means of pistons, vanes or blades, which entail complexity of construction and impose many limi-

tations on the propelling as well as propelled mechanism and its performance. Tesla has dispensed with these devices and produced machines of extraordinary simplicity which, moreover, are in many other respects superior to the old types universally employed. A few words will be sufficient to convey a clear idea of his invention.

Every fluid, as water or air, possesses two salient properties; adhesion and viscosity. Owing to the first it is attracted and clings to a metallic surface; by virtue of the second it resists the separation of its own particles. As an inevitable consequence a cer-

tain amount of fluid is dragged along by a body propelled through it; conversely, if a body be placed in a fluid in motion it is impelled in the direction of movement. The practical forms of Tesla's apparatus consist of flat, circular disks, with central openings, mounted on a shaft and enclosed in a casing provided with ports at the peripheral and central portions. When deriving energy from any kind of fluid it is admitted at the periphery and escapes at the centre; when, on the contrary, the fluid is to be energised, it enters in the centre and is expelled at the periphery. In either case it traverses the in-

terstices between the disks in a spiral path, power being derived from, or imparted to it, by purely molecular action. In this novel manner the heat energy of steam or explosive mixtures can be transformed with high economy into mechanical effort; motion transmitted from one shaft to another without solid connection; vessels may be propelled with great speed; water raised or air compressed; an almost perfect vacuum can be attained, substances frozen and gases liquefied.

While this improvement has the broadness and applicability of a fundamental mechanical concept, the widest field for its

commercial exploitation is, obviously, the thermo-dynamic conversion of energy.

The commercial value of a prime-mover is determined by its efficiency, specific performance relative to weight and space occupied, cheapness of manufacture, safety and reliability of operation, adaptability to construction in large units, capability of running at high peripheral velocity, reversibility, and a number of other features of lesser importance. In the majority of these a machine, operating on the new principle, excels. But there is one quality which is most desirable in a thermo-dynamic transformer from the

economic point of view, and that is great resistance to deterioration and impairment of efficiency by heat.

The employment of high temperature is of such vital bearing on the efficiency of prime-movers that it is of paramount importance to extend the thermal range as far as practicable. In the present state of the art radical progress towards more economical transformation of the energy of fuel can only be achieved in that direction. Such being the case, the capability of the machine to withstand deteriorating effects of great heat is the controlling factor in determining its commercial value. In that most desired quality the

Tesla turbine surpasses all the older types of heat motors. The Diesel and other internal combustion engines are fatally limited in this respect by their complete dependence on closely fitting sliding joints and unfailing supply of clean lubricant; while in the present forms of turbines buckets, blades and inherent mechanical deficiencies impose similar restrictions. These parts are too delicate and perishable to serve as elements of a gas turbine and this has been the main obstacle in the way of its successful realisation. The rotor of the Tesla turbine presents a relatively enormous

active area and the wear is quite insignificant as the fluid, instead of striking against the propelling organs in the usual destructive manner, flows parallel with the same, imparting its momentum by adhesion and viscosity instead of impact. Moreover, it has been shown that the efficiency of this form of rotor is not impaired to any appreciable degree by a roughening of the disks and that it operates satisfactorily even if the working medium is corrosive to an extent.

The universal adoption of steam as motive power under certain standard conditions, settled upon in the course of time, gradually forced upon the minds of engineers the Rankine

Cycle Efficiency as criterion of performance and long continued endeavors to improve the same have finally resulted in complex multistage constructions entirely unsuitable for high temperatures. The Tesla turbine, by virtue of its exceptional heat-resisting and other unique properties, makes possible the attainment of great fuel economy with but a single stage, incidentally offering the additional advantages of an extremely simple, small, compact, and reliable mechanism. But perhaps the chief commercial value of this new prime-mover will be found in the fact that it can be operated with the cheapest grade of crude oil, colloidal fuel, or powdered coal, containing con-

siderable quantities of grit, sulphur and other impurities, thus enabling vast sums of money to be saved annually in the production of power from fuel.

The Tesla turbine also lends itself to use in conjunction with other types, especially with the Parsons with which it forms an ideal combination. Although its practical introduction has been delayed by the force of circumstances, a number of years have been spent in exhaustive investigations and experiments on the basis of which the performance in any given case can be closely calculated. The first public tests were made before the

outbreak of the war at the Waterside Station of the New York Edison Company where several machines, ranging from 100 to 5000 h.p., were installed and operated with satisfactory results. That the invention was appreciated by the technical profession may be seen from the excerpts of statements by experts and periodicals printed on the annexed page.

The salient advantages of the Tesla turbine may be summed up as follows:

EFFICIENCY: The most economical of the present primemovers is the Diesel engine. But, quite apart of many practical and com-

mercial drawbacks, inseparable from this type, it is entirely dependent on comparatively expensive oil, so that the Tesla Gas Turbine, working with much cheaper fuel, would have the better in competition even if its efficiency as a thermodynamic transformer were appreciably lower, all the moreso in view of its greater mechanical perfection.

Referring to turbines, all of which are surpassed by the Parsons in economy as well as extent of use, definite limits have already been reached and the only possibilities of saving fuel exist in the employment of steam at very high superheat

and utilisation of gas or oil as motive fuel. But none of the primemovers mentioned is adapted for such operation and although every effort has been made in this direction, no signal success has been achieved. The superheat is at most 250° F, this being considered the maximum permissible. All attempts to considerably extend the thermal range have failed chiefly because of the inability of bucket structures to withstand the action of intense heat. The Tesla turbine can operate quite satisfactorily with the motive agent at very high temperature and, owing to this quality,

lends itself exceedingly well to these purposes.

SPECIFIC PERFORMANCE: In this particular it is superior to all other forms. Each disk is virtually the equivalent of a whole bucket wheel, and as many of them take up but a small width the output of the machine, considering its weight and size, is surprisingly great. This, while not being a measure of efficiency, is nevertheless a feature of considerable importance in many instances.

CHARACTER OF MANUFACTURE: The new turbine can be produced without a single machined part except the shaft, all the disks being punched

and the casings pressed. By this method, with proper machinery installed on a large scale, the cost of production many be reduced to a figure never deemed possible in the construction of an engine. What is more, this can be done without material sacrifice of efficiency as small clearances are not essentially required.

SAFETY AND RELIABILITY OF OPERATION: There is an ever present danger in the running of high speed machines. A bucket turbine may at any moment run away and wreck the plant. Such accidents have happened again and again and this

peril has often proved a deterrent to investment.

A remarkable quality of this turbine is its complete safety. As regards the wear and tear of the propelling organs it is significant and, in any event, of no consequence on the performance.

ADAPTABILITY TO CONSTRUCTION IN LARGE UNITS: In all the present machines there is a distinct limit to capacity, for although large units can be manufactured, they are very costly and difficult to manage. The new turbine is so simple and the output so large that the limits in this direction can be greatly extended.

RESISTANCE TO DETERIORATION BY HEAT AND OTHER AGENTS: In this feature again it has an overwhelming advantage over the old types in which the maintenance of smooth surfaces and sharp edges is indispensable to efficient working. In the Tesla Turbine, for the reasons already stated, the destructive actions of heat and corrosive agents are much less pronounced and of relatively negligible effect. This fact has a most important bearing on the saving of fuel.

CAPABILITY OF RUNNING AT HIGH PERIPHERAL SPEED: In this respect also it is superior to others. The rotating structure carries no load and is

excellently adapted to withstand tensile stresses. Judging from the most recent turbine practice this quality should be of special value.

REVERSIBILITY: The present turbines are greatly handicapped by their incapability of reversal which is a very serious defect in certain applications, as the propulsion of vessels, necessitating the employment of auxiliary turbines which detracts from the propulsive power and adds materially to the cost of production and maintenance of the equipment. The Tesla Turbine has the unique

property of being reversible, not only this but it operates with the same efficiency in either direction. For marine purposes it therefore constitutes an ideal motor whether used alone or in conjunction with older types.

Besides the above it possesses other desirable features, constructive and operative, which will add to its value and adaptability to many industrial and commercial uses as, railroading, marine navigation, aerial propulsion, generation of electricity, refrigeration, operation of trucks and automobiles, hydraulic gearing, agriculture, irrigation, mining and similar purposes.

EXPRESSIONS OF OPINION ON THE TESLA TURBINE

C. B. Richards, Professor Emeritus of Mechanics, Yale University: "I am amazed at the development of power given by the turbine and stunned by the exhibit."

F. Sargent, Chief Engineer and Turbine Expert: "I am impressed with the newness and novelty of the underlying principle of this invention. It is such as will claim the attention and admiration of anyone of a scientific turn of mind in a mechanical direction."

Reynold Janney, Chief Engineer, Universal Transmission Co: "It is a great invention."

Brigadier Allen of the War Department: "Something new in the world. Officers are greatly impressed with it."

Miller Reese Hutchinson, Chief Engineer: "It is the greatest invention of the age."

Arnold Irinyi, Chief Engineer, Oelfeurungs-Gesellschaft, Germany: "The ideal of the turbine engine."

B. R. T. Collins (Power Plant Economist): "It is a wonderful turbine."

The Motor World: "The new principle unquestionably is a great contribution to science and engineering, great in its simplicity and breadth of application."

Scientific American: "Considered from the mechanical standpoint, the turbine is astonishingly simple and economical in construction, should prove to possess such a durability and freedom from wear and breakdown as to place it, in these respects, far in advance of any type of steam or gas motor of the present day."

Engineering Magazine: "An entirely new form of prime mover with interesting possibilities."

Technical World Magazine: "The Tesla Turbine is the apotheosis of simplicity. It is so violently opposed to all precedent that it seems unbelievable."

From Numerous Articles and Comments:

"The turbine is different in principle to any heretofore in use and one which will take less room and less coal than the best engine now running"..... "Turbine of revolutionary design"..... "Improvement in dynamics which promises revolutionary results".. "Results seem revolutionary to the point of staggering the imagination"...."This motor will revolutionize the turbine industry"...."Wonderful motor. Extraordinary mechanical principle"..... etc. etc.